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(71) Applicant: SEIKO EPSON CORPORATION  
Shinjuku-ku Tokyo (JP)

(72) Inventors:  
• Matsuzaki, Makoto  
Suwa-shi, Nagano (JP)  
• Shinada, Satoshi  
Suwa-shi, Nagano (JP)

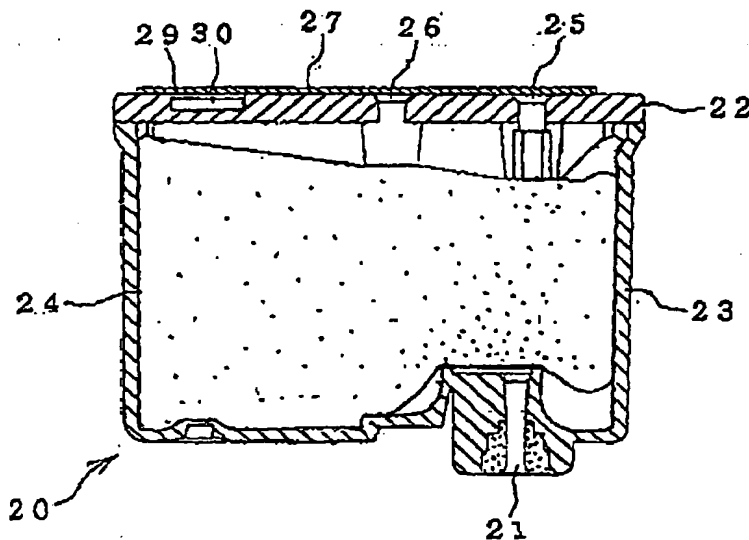
(74) Representative: Sturt, Clifford Mark et al  
Miller Sturt Kenyon  
9 John Street  
London WC1N 2ES (GB)

### (54) Ink cartridge for ink-jet printing apparatus

(57) An ink cartridge (20) is composed of the body of a container (23) provided with an ink supply port (21) for discharging ink into a print head for housing ink and a cap for sealing the body of the container so that the container can communicate with the air, a semiconductor memory device (30) storing information related to ink

is mounted on the surface of the body of the container or the cap and is coated with a film organizer (27) which can be peeled. The semiconductor memory device is prevented by the film organizer as much as possible from being exposed so as to prevent the information of ink from being lost due to the rough handling of a user.

Fig. 2



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## Description

### BACKGROUND OF THE INVENTION

#### Field of the Invention:

[0001] The present invention relates to an ink cartridge suitable for an ink-jet printing apparatus in which an ink-jet print head is provided to a reciprocating carriage and an ink cartridge is detachably mounted on the carriage, and more particularly relates to an ink cartridge provided with a memory device such as a semiconductor chip storing thereon information related to the ink cartridge or ink contained in the ink cartridge.

#### Related Art:

[0002] An ink-jet printing apparatus with a print head generates a driving signal in accordance with print data and applied same to a pressure generating section such as a piezoelectric vibrator and a heating section, so that the ink within a pressure generating chamber is pressurized and ink droplets eject from nozzle apertures formed in the print head. The ink-jet printing apparatus of this type is also provided with an ink cartridge for supplying ink to the print head.

[0003] As the printing quality is determined by the resolution of a print head and, in addition, greatly depends upon the viscosity of ink, a condition of bleeding on a recording medium and others, the characteristics of ink and a driving signal applied to the print head are improved to enhance the quality of printing. Further, the cycle of ink-missing ejection has been improved for preventing the nozzle apertures from being clogged, and also the maintenance conditions such as forced ejection of ink droplets into a cap of a cleaning mechanism has been improved.

[0004] Therefore, there has often been proposed a semiconductor memory device storing data related to ink or ink cartridge which is provided to an ink cartridge, so that the data is read from the memory device by a printing apparatus, printing is executed under an optimum condition, or data related to a state in which the ink cartridge is used is stored in the semiconductor memory device.

[0005] For example, as disclosed in Japanese published unexamined patent application No. Hei. 3-67657, there has been proposed an ink cartridge wherein a semiconductor memory chip is mounted on an upper surface of a container composing the ink cartridge so that data can be read out by a printing apparatus via a substrate and an ink cartridge wherein a recessed portion is formed in the ink cartridge and a semiconductor memory chip is fitted in the recessed portion so that data can be read out.

[0006] However, as the above semiconductor memory chip is mounted in a state in which it is always left exposed, there is a problem that users may readily come

to touch the semiconductor memory chip with their fingers, and the memory chip may be broken or lost due to static electricity or others. If such happens, the printing apparatus would not read out information stored on the semiconductor memory chip for proper printing.

[0007] According to the conventional ink cartridge with a semiconductor memory device, it is required to provide an extra mechanism for fixing the semiconductor memory device to an ink cartridge which causes another problem of rising up the manufacturing cost and also the manufacturing process becomes complicated.

### SUMMARY OF THE INVENTION

[0008] Therefore, a first object of the present invention is to provide an ink cartridge for an ink-jet printing apparatus capable of preventing information related to the ink cartridge or ink in the cartridge from being broken or lost due to the rough handling of a user.

[0009] A second object of the present invention is to provide an ink cartridge for an ink-jet printing apparatus which enables a memory device such as a semiconductor chip to be readily mounted without requiring special mechanism and structure of the cartridge.

[0010] Another object of the present invention is to provide an ink jet printing apparatus mounting thereon an ink cartridge with a memory device capable of achieving any one of the foregoing objects.

[0011] Still another object of the present invention is to provide a sticker component including a seal tape and a memory device such as a semiconductor chip for an ink cartridge mountable on an ink jet printing apparatus, which sticker component capable of achieving any one of the foregoing objects.

[0012] The above and other objects can be achieved by a provision of an ink cartridge which, according to the present invention, a housing having an opening and containing ink therein; a lid covering the opening of the housing; an ink supply port formed on a wall of the housing; the ink supply port discharging ink out of the housing; a memory device storing information of the ink cartridge or ink in the cartridge; and a seal member stuck to a part of the housing and the memory device.

### BRIEF DESCRIPTION OF THE DRAWINGS

#### [0013]

Fig. 1 shows an embodiment of a printing mechanism of an ink-jet printing apparatus for executing printing using an ink cartridge according to the present invention;

Fig. 2 is a sectional view showing an embodiment of the ink cartridge according to the present invention;

Figs. 3a to 3c respectively show the embodiment of the ink cartridge in a state before a film is installed, in a state in which a film is installed and in a state

in which a part of a film is peeled for use;

Fig. 4 is a top view showing an embodiment of a memory device mounted on the ink cartridge;

Fig. 5 is a block diagram showing an embodiment of a controller;

Fig. 6 is a sectional view showing a state in which the ink cartridge is installed in the printing apparatus;

Figs. 7a to 7c respectively show an embodiment of the ink cartridge in a state before a film is installed, in a state in which a film is installed and in a state in which a part of a film is peeled for use, and Fig. 8 is a sectional view showing the structure of a holder suitable for the above ink cartridge in a state in which the ink cartridge is installed;

Figs. 9a to 9c and Figs. 10a to 10c respectively show the other embodiment of the ink cartridge in a state before a film is installed, in a state in which a film is installed and in a state in which a part of a film is peeled for use;

Fig. 11 is a perspective view showing a sealing film for an ink cartridge according to another embodiment of the invention;

Fig. 12 is a perspective view of the ink cartridge and sealing films according to another arrangement of the invention; and

Fig. 13 is a top view showing the other embodiment of the memory device mounted on the ink cartridge.

#### PREFERRED EMBODIMENTS OF THE INVENTION

[0014] Fig. 1 shows an embodiment of a printing mechanism of an ink-jet printing apparatus for executing printing using an ink cartridge according to the present invention, a cartridge holder 6 provided with a pivotable lever 5 is formed on a carriage 4 connecting to a drive motor 2 via a timing belt 1 and guided by a guide bar 3 and a print head 8 to which ink is supplied from the ink cartridge via an ink supply needle 7 is also provided on the lower surface of the carriage.

[0015] The carriage 4 connects to a control section 10 described later via a flexible cable 9. The printing apparatus is also provided with a paper feed motor 11 for driving a paper feed mechanism 12 and a pump unit 13 and a cleaning mechanism 14 for cleaning the clogging of nozzle apertures of the print head 8.

[0016] Fig. 2 shows an embodiment of an ink cartridge 20. The ink cartridge is composed as a container 23 having an ink supply port 21 at the bottom thereof into which an ink supply needle 7 of the printing apparatus is inserted and an opening at the top thereof which is sealed with a lid 22. A porous member 24 impregnated with ink is accommodated in the container 24.

[0017] An ink inlet 25 and an air communicating port 26 are formed in a surface of the lid 22. The air communicating port 26 connects to an end of a fine groove 28 sealed by a sealing film 27 as shown in Fig. 3. The sealing film 27 is provided with a first seal part 27a and a

second seal part 27b. The fine groove 28 formed on an outer surface of the lid 22 performs to generate the capillary action. The other end of the fine groove 28 extends to an area which covers the removable second seal part 27b of the sealing film 27. A recessed portion 29 is formed in a position of the second, removable part 27b of the film 27 is stuck and a memory device 30 fits in the recessed portion. According to the present embodiment, the sealing film 27 sticks onto the lid 22 and covers the memory device 30 fitted in the recessed portion 29 in such a manner that a gap is defined between the memory device 30 and the sealing film 27. Further, no sticking layer or material is applied to the part of the sealing film 27 which faces the recessed portion 29. It is desirable that the sealing film 27 in an area sealing the recessed portion 29 is formed at least partly from a material having an air impermeable characteristics and/or electrical conductivity. In a case where the sealing film 27 is conductive, because the conductive material holds and discharge the static electricity the adverse affect due to the static electricity is hardly applied to the memory storing part of the memory device 30.

[0018] Fig. 4 shows an embodiment of the memory device 30, which serves as a memory module for storing therein information. A semiconductor memory chip 32 serving as an information storing part, is mounted on a circuit board 31, and conductive patterns 33 respectively connected to the semiconductor memory chip 32 and electrodes 34 respectively connecting to a group of contacts of the printing apparatus are formed.

[0019] As shown in Fig. 3a, after the memory device 30 is mounted so that it fits into the recessed portion 29 formed in the lid 22 of the ink cartridge 20 and decompression processing is applied if necessary, the sealing film 27, which has sufficient air impermeable characteristics is stuck onto the outer surface of the lid 22 so that the film covers the ink inlet 25, the air communicating port 26, the fine groove 28 and the recessed portion 29 with the semiconductor memory chip 30.

[0020] Fig. 5 shows an embodiment of the controller, a main control unit 40 receives print data from a host computer via an interface circuit 42 according to a command from an operator panel 41 and controls a printing control unit 44 based upon the print data according to a control program stored in an internal memory 43. The printing control unit 44 controls printing operation to drive the carriage motor 2 and the paper feed motor 11, the print head 8 vertically and horizontally scans and ink droplets are ejected from nozzles of the print head 8. The controller also operates the cleaning mechanism 14 to cope with the clogging of the print head 8 when a command is issued via the operator panel 41 or when a power source is turned on.

[0021] In addition to the above regular control operation in the ink-jet printing apparatus, the main control unit 40 controls printing operation by communicating with the memory device 30 provided to the ink cartridge 20 and reading the information of the ink cartridge such

as the ink composition, production data code, model number or the like.

[0022] Communication between the memory device 30 of the ink cartridge 20 and the printing apparatus is executed in this embodiment when a detecting section 46 detects new connection between each electrode 34 of the memory device 30 and the respective one of the group of contacts 45 provided to the lever 5 or when the main control unit 40 reads data stored in the semiconductor chip 32 in power on.

[0023] In this embodiment, when the ink cartridge 20 is distributed and a user unpacks the ink cartridge, the memory device 30 is still covered with the sealing film 27 and is still out of contact with a user.

[0024] When a removable part of the film 27 is peeled as shown in Fig. 3c before the use of the ink cartridge, an air communication hole 28a and a part of the fine, circuitous groove 28 becomes open to atmospheric air and also the memory device 30 is first exposed. In this state, when the ink cartridge 20 is installed in the holder 6 with the ink cartridge properly directed and the lever 5 is turned up to an end, the ink supply needle 7 inserts into the ink supply port 21 as shown in Fig. 6, the ink supply from the ink cartridge 20 to the print head 8 is enabled and as each of the group of contacts 45 of the lever 5 and each electrode 34 of the memory device 30 come into contact, the information of the ink cartridge 20 is read out from the memory device 30 and then a proper or optimum printing is enabled.

[0025] In this embodiment, as the memory device 30 is housed in the recessed portion 29 integrated with the ink cartridge 20, the electrodes 34 are precisely positioned and secure communicating between the electrodes and the printing apparatus can be secured.

[0026] Figs. 7a to 7c respectively show another embodiment of the ink cartridge according to the present invention. In this embodiment, a recessed portion 29' is formed on one of the side wall 23a of a container 23 serving as the ink cartridge, on which side the ink supply port is located closer. The above memory device 30 is fitted in the recessed portion 29' in the side wall 23a.

[0027] A part including an ink inlet port 25, an air communicating port 26 and a fine, circuitous groove 28 performing a capillary action and in the vicinity of a port open to the air are sealed by a first sealing film 50. In addition, an air communication hole 28a is formed on the ink cartridge in the vicinity of the recessed portion 29'. The air communication hole 28a is sealed by a second sealing film 51 which can be peeled so that the second film overlaps with a part of the first film 50. An adhesive is applied only to the stuck area 51a of the second film 51 and one end 51b is kept in a lifted state so that it functions as a handhold when the second film is peeled off.

[0028] When the ink cartridge is installed in a normal position as shown in Fig. 8, a group of contacts 45 are arranged in a position opposite to the recessed portion 29' of the ink cartridge 20 in which the memory device

30 is provided.

[0029] In this embodiment, when the second sealing film 51 is peeled as shown in Fig. 7c, the fine groove 28 becomes open to the air and the memory device 30 on the side wall 23a is exposed. In this state, when the ink cartridge 10 is installed in a holder 6 and the lever 5 is pivoted to an end, each of the group of contacts 45 comes into contact with the respective electrode 34 of the memory device 30 in a state where an ink supply needle 7 is inserted into an ink supply port 21 as shown in Fig. 8, the information of the ink cartridge 20 stored on the memory device 30 is read out and the proper or optimum printing is realized.

[0030] In the above embodiments, the recessed portions are formed respectively in the lid 22 of the ink cartridge or in the container 23 and the memory device 30 is housed in the recessed portion. According to another embodiment, a memory device 30 is secured to a label or sticker stuck on each surface of respective areas 52a and 53a left on an ink cartridge after unsealing of sealing films 52 and 53 stuck on the ink cartridge 20 as shown in Figs. 9a to 9c and Figs. 10a to 10c. Therefore, the accurate positional relationship of the memory device 30 can be achieved.

[0031] As shown in Figs. 9(a) to 9(c), a memory device 30 is attached or adhered onto a first sealing part 52a of the sealing film 52, and a second sealing part 52c is removed out when the ink cartridge is in use so that the air communication hole 28a comes to open to atmosphere. In an arrangement in Figs. 10(a) to 10(c), an edge of the first sealing part 53a of the sealing film 53 extends to reach the side wall of the ink cartridge when the sealing film is attached to the cartridge, and the memory device 30 is attached or adhered to a part of the first sealing part 53a which is disposed on the side wall of the ink cartridge. According to the arrangement, the width of the part of the first sealing part 53a, which is disposed on the side wall of the ink cartridge, is smaller than that of the other part of the first sealing part 53a as shown in Figs. 10(a) to 10(c).

[0032] In these embodiments, after the film 52 or 53 is stuck on the lid 22 of the cartridge 20, the memory device 30 is fixed in a defined position by an adhesive and others or after the memory device 30 is fixed in a defined position on the film beforehand, the film 52 or 53 is stuck on the lid 22 so that the memory device 30 is located in a defined position of the cartridge.

[0033] According to the foregoing embodiments, the above recessed portions 29 and 29' for housing the memory device in the lid 22 and the container 23 respectively composing the ink cartridge are not required, and not only the manufacturing process can be simplified but the memory device can be readily provided to the ink cartridge without changing a metal mold for injection molding used for manufacturing a conventional type ink cartridge.

[0034] Fig. 11 is a perspective view showing a sealing film 52 for an ink cartridge according to another embod-

iment of the present invention. In this embodiment, the position of the memory device 30 shown in Fig. 9. As shown in Fig. 11, a memory device 30 is attached onto a sticking side of a sealing film 52 so that the memory device 30 may be fitted in a recessed portion 60 formed in the lid 22 of the ink cartridge. It is necessary to form the recessed portion 60 in this embodiment, however, it is readily assemble the memory device to the ink cartridge in the sealing film attaching process during manufacturing. In addition, there arises no possibility of being damaged by external affect such as in advertent touch by person's fingers.

[0035] This type of ink cartridge can be realized in a printing apparatus having a non-contact type communication system as described below.

[0036] Fig. 12 is a perspective view of the ink cartridge and sealing films according to another arrangement of the present invention. The sealing film of this arrangement includes a first film 61 onto which the memory device 30 is stuck and a second film 62 for sealing the air communication hole 28a and a part of the fine groove 28. Since the second film 62 has a size enough to cover the memory device 30 stuck on the first film 61, the similar advantage to the above can be accomplished. In addition, this type of the arrangement can also be employed also in a printing apparatus having a contact type communication system.

[0037] In the above embodiments of the invention, communication between the semiconductor chip of the memory device and the printing apparatus is realized by contact between the electrodes and the group of contacts. However, as shown in Fig. 13, non-contact type communication may be employed such as radio-communication means 35. The non-contact type communication may include, for example an electromagnetic wave transmitting/receiving module, an optical communication module and an ultrasonic communication module and a semiconductor memory chip 32 can communicate in a non-contact state by mounting them on a circuit board and connecting the radio-communication means and the semiconductor memory chip 32 via a conductive pattern 36, and a problem caused by the failure of contact between an electrode and a contact can be avoided.

[0038] Further, according to the present invention, if desired, another type of information storing part may also be employed such as a magnetic recording medium other than the semiconductor memory chip.

[0039] According to the invention, the memory device 30 may be entirely constituted by a semiconductor chip if desired.

[0040] Also, in the above embodiments, the cartridge for housing one type of ink is described, however, it is clear that even if the present invention is applied to a color ink cartridge wherein a container is divided into plural chambers for housing different inks by a partition or partitions and ink supply ports communicating with each chamber are formed, the similar action is pro-

duced.

## Claims

### 1. An ink jet printer comprising:

a print head including a plurality of nozzles through which ink is ejected;  
an ink supply needle connecting to said print head;  
an ink cartridge containing ink therein, said ink cartridge being mounted on the printer and engaging with said ink supply needle, said ink cartridge comprising:

a housing having an opening;  
a lid covering said opening of said housing;  
an ink supply port formed on a wall of said housing, said ink supply port being engageable with said ink supply needle;  
a memory device storing information of the ink cartridge;  
a seal member stuck to a part of said housing or said lid and engaging with said memory device;

a detecting device for detecting information stored in said memory device; and  
a control section connecting to said detecting device and receiving information from said detecting device.

### 2. The ink jet printer of claim 1, wherein said memory device is mounted on said lid.

### 3. The ink jet printer of claim 1, wherein said memory device is mounted on a side wall of said housing.

### 4. The ink jet printer of claim 1, further comprising a recess formed in said lid, and said memory device is mounted in said recess.

### 5. The ink jet printer of claim 1, further comprising a recess formed in a side wall of said housing, and said memory device is mounted in said recess.

### 6. The ink jet printer of claim 4 or 5, wherein said memory device engages with said seal member through a gap defined therebetween.

### 7. The ink jet printer of claim 1, wherein said ink cartridge further comprises an air communication hole and a fine groove formed in said lid, which are covered by said seal member.

### 8. The ink jet printer of claim 1, wherein said seal member comprises a first seal part and a second

- seal part, said second seal part being torn off when the ink cartridge is in use.
9. The ink jet printer of claim 8, wherein said memory device is covered with said second seal part and exposed when said second seal part is torn off.
10. The ink jet printer of claim 8, wherein said memory device is secured on an outer surface of said first seal part.
11. The ink jet printer of claim 8, wherein said first seal part is separated from said second seal part.
12. The ink jet printer of claim 8, wherein said first seal part partly connects to said second seal part.
13. The ink jet printer of claim 1, wherein said seal member is formed from air impermeable material.
14. The ink jet printer of claim 1, wherein said seal member is formed from conductive material.
15. The ink jet printer of claim 1, wherein said detecting device comprises a non-contact type communication system.
16. The ink jet printer of claim 15, wherein said non-contact type communication system comprises an electromagnetic wave communication device.
17. The ink jet printer of claim 15, wherein said non-contact type communication system comprises an optical communication device.
18. The ink jet printer of claim 15, wherein said non-contact type communication system comprises an ultrasonic wave communication device.
19. The ink jet printer of claim 1, wherein said memory device comprises at least one electrode, and said detecting device comprises at least one terminal which is engageable with said electrode of said memory device.
20. The ink jet printer of claim 1, wherein said memory device comprises a semiconductor chip.
21. An ink cartridge for an ink jet printer, comprising:  
 a housing having an opening and containing ink therein;  
 a lid covering said opening of said housing;  
 an ink supply port formed on a wall of said housing, said ink supply port discharging ink out of said housing;  
 a memory device storing information of the ink cartridge; and  
 a seal member stuck to a part of said housing or said lid and engaging with said memory device.
22. The ink cartridge of claim 21, wherein said memory is mounted on said lid.
23. The ink cartridge of claim 21, wherein said memory is mounted on a side wall of said housing.
24. The ink cartridge of claim 21, further comprising a recess formed in said lid, and said memory device is mounted in said recess.
25. The ink cartridge of claim 21, further comprising a recess formed in a side wall of said housing, and said memory device is mounted in said recess.
26. The ink cartridge of claims 24 or 25, wherein said memory device engages with said seal member through a gap defined therebetween.
27. The ink cartridge of claim 21, further comprising an air communication hole and a fine groove formed in said lid.
28. The ink cartridge of claim 21, wherein said seal member comprises a first seal part and a second seal part, said second seal part being torn off when the ink cartridge is in use.
29. The ink cartridge of claim 28, wherein said memory device is covered with said second seal part and exposed when said second seal part is torn off.
30. The ink cartridge of claim 28, wherein said memory device is secured on an outer surface of said first seal part.
31. The ink cartridge of claim 28, wherein said first seal part is separated from said second seal part.
32. The ink cartridge of claim 28, wherein said first seal part partly connects to said second seal part.
33. The ink cartridge of claim 21, wherein said seal member is formed from air impermeable material.
34. The ink cartridge of claim 21, wherein said seal member is formed from conductive material.
35. The ink cartridge of claim 21, wherein said detecting device comprises a non-contact type communication system.
36. The ink cartridge of claim 21, wherein said memory device comprises at least one electrode.

37. The ink cartridge of claim 21, wherein said memory device comprises a semiconductor chip.
38. The ink cartridge of claim 27, wherein said seal member covers said fine groove formed in said lid. 5
39. The ink cartridge of claim 27, wherein said seal member comprises a first seal part and a second seal part, and said air communication hole and said memory device are left open when said second seal part is torn off. 10
40. The ink cartridge of claim 28 or 39, wherein said memory device is disposed between said first seal part and said lid. 15
41. The ink cartridge of claim 27, wherein said seal member comprises a first film on which said memory device is attached and a second film covering said memory device and said air communication hole. 20
42. The ink cartridge of claim 27, wherein said memory device is disposed in the vicinity of said air communication hole. 25
43. A sticker component for an ink cartridge which is mountable onto an ink jet printer, the sticker component comprising: a thin sticker member stuck on to at least one wall of the ink cartridge; and a memory device stuck to said sticker component, said memory device storing information of the ink cartridge. 30
44. The sticker component of claim 43, wherein said memory device is mounted on a lid of the ink cartridge. 35
45. The sticker component of claim 43, wherein said memory device is mounted on a side wall of the ink cartridge. 40
46. The sticker component of claim 43, wherein said memory device is mounted in a recess formed in a lid of the ink cartridge. 45
47. The sticker component of claim 43, wherein and said memory device is mounted in a recess formed in a side wall of the ink cartridge. 50
48. The sticker component of claim 43, wherein said sticker member comprises a first seal part and a second seal part, said second seal part being torn off when the ink cartridge is in use. 55
49. The sticker component of claim 48, wherein said memory device is secured on an outer surface of said first seal part.
50. The sticker component of claim 48, wherein said first seal part of said sticker member is separated from said second seal part thereof.
51. The sticker component of claim 48, wherein said first seal part of said sticker member partly connects to said second seal part thereof.
52. The sticker component of claim 43, wherein said sticker member is formed from an air impermeable material.
53. The sticker component of claim 43, wherein said sticker member is formed from a conductive material.
54. The sticker component of claim 43, wherein said memory device comprises at least one electrode.

Fig. 1

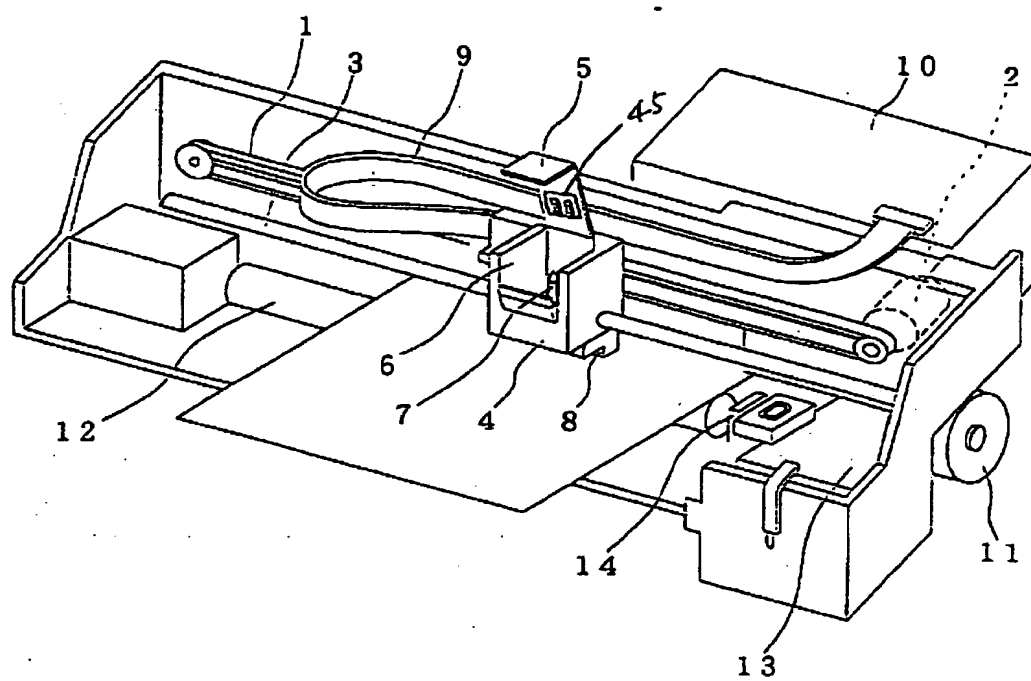




Fig. 2

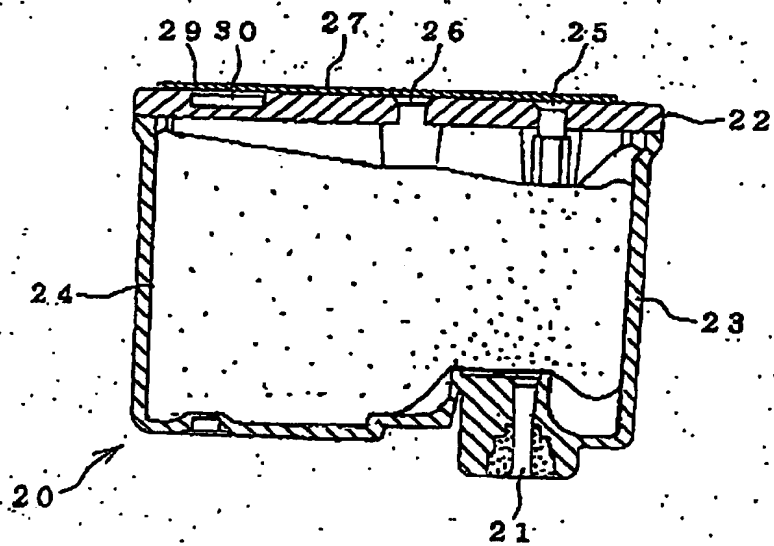


Fig. 3

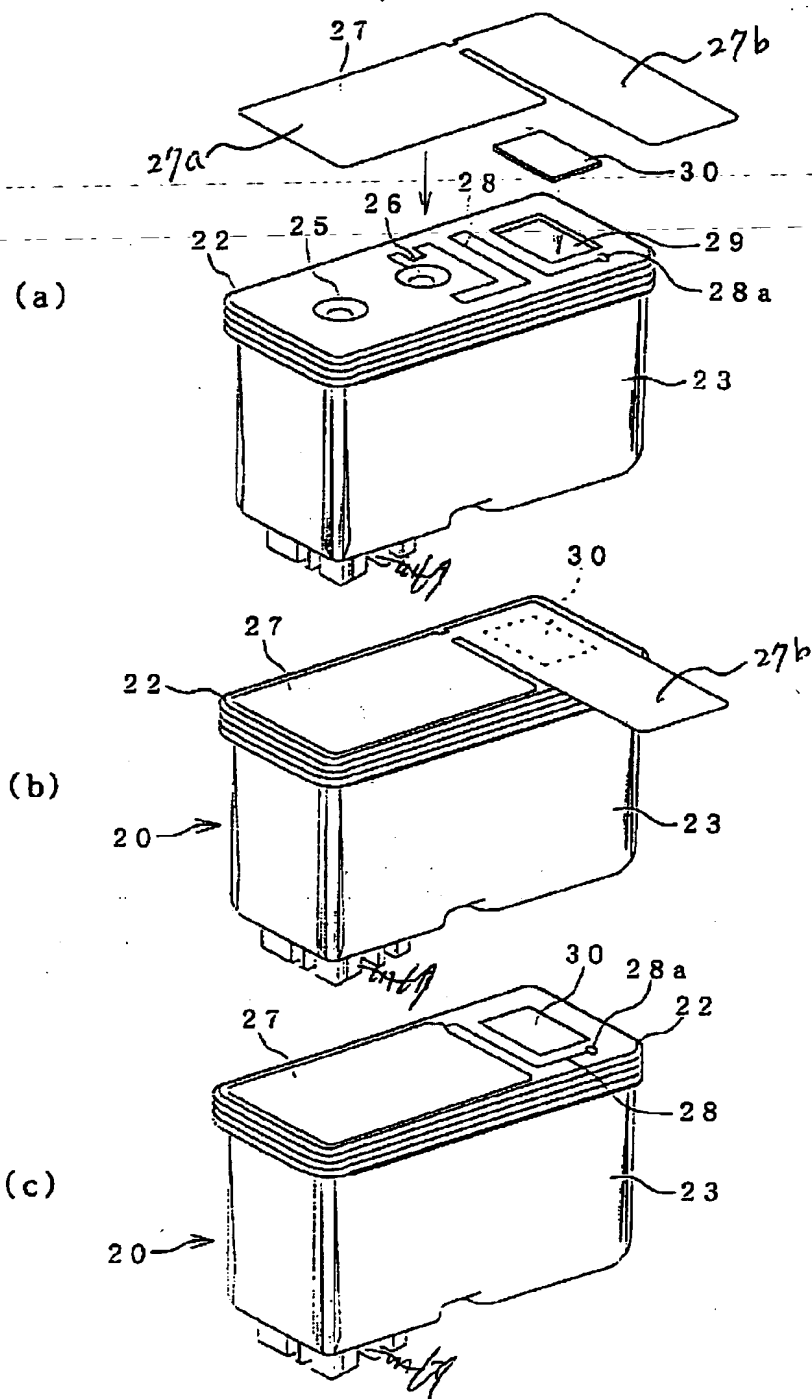


Fig. 4

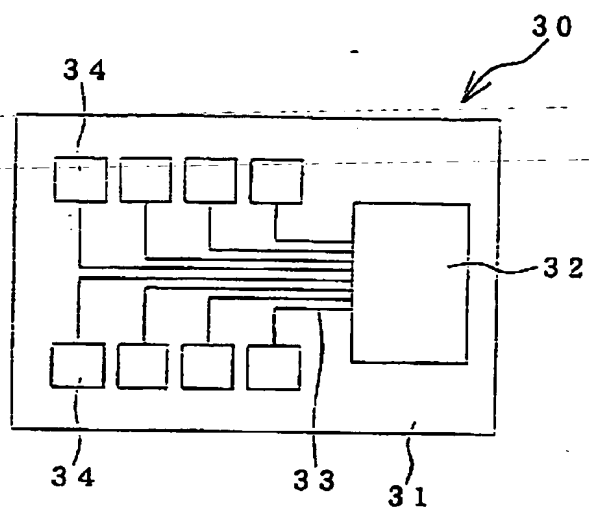


Fig. 13

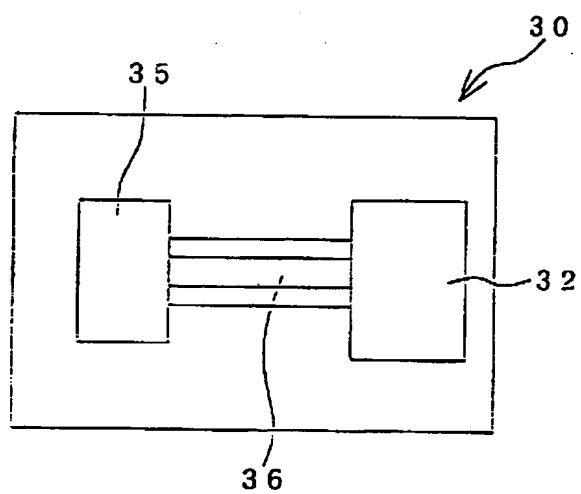


Fig. 5

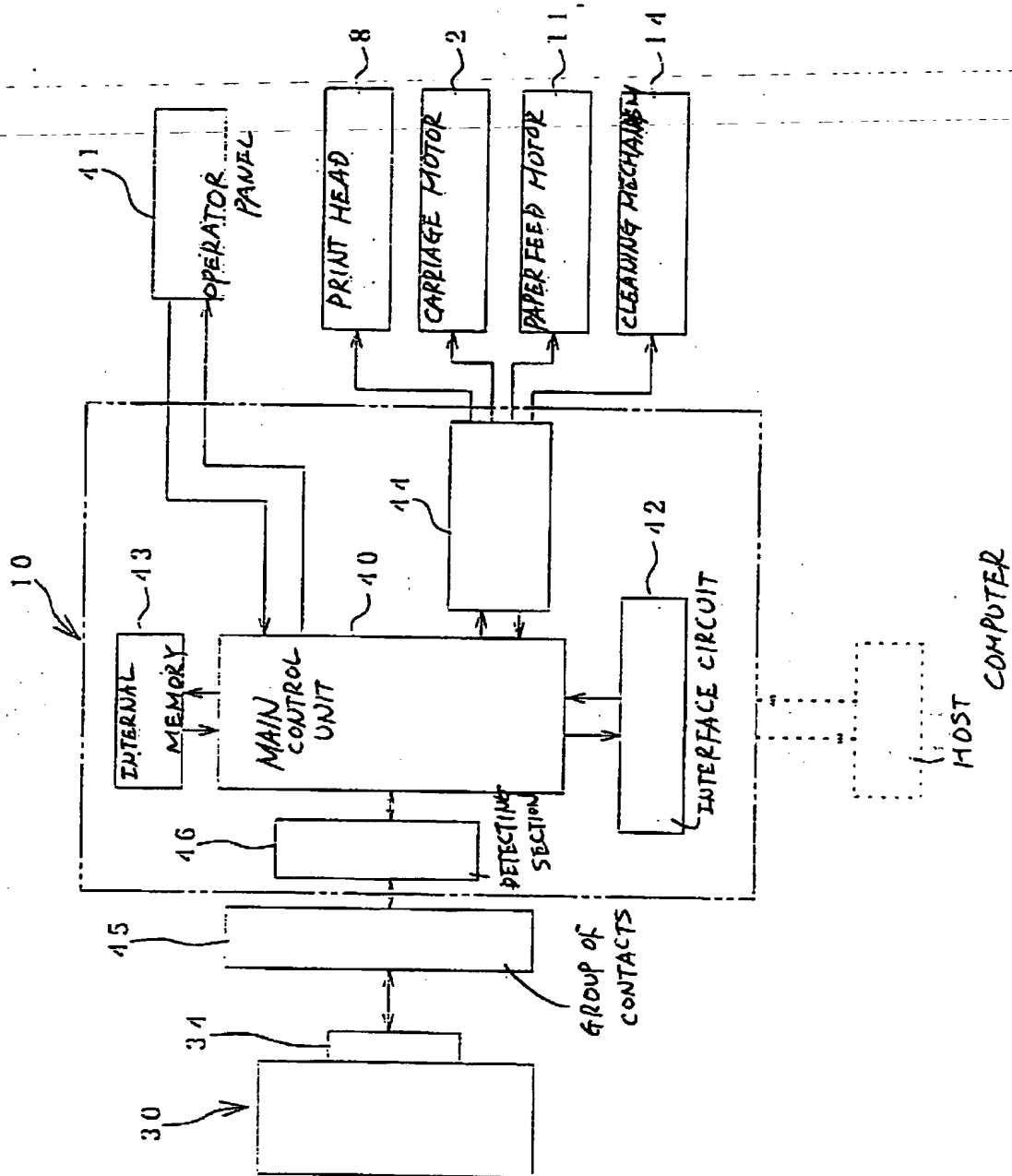


Fig. 6

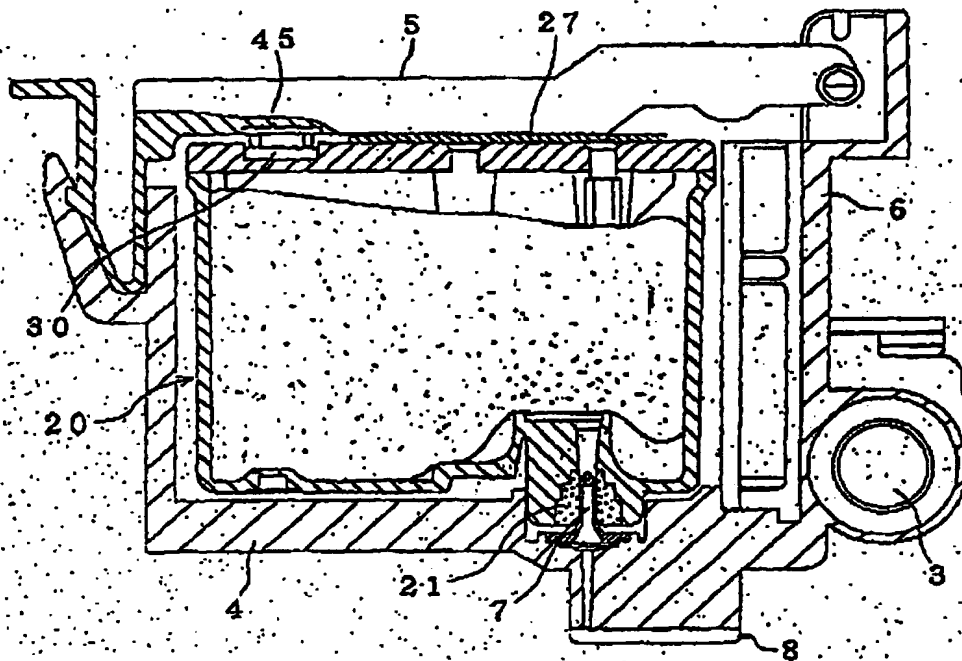
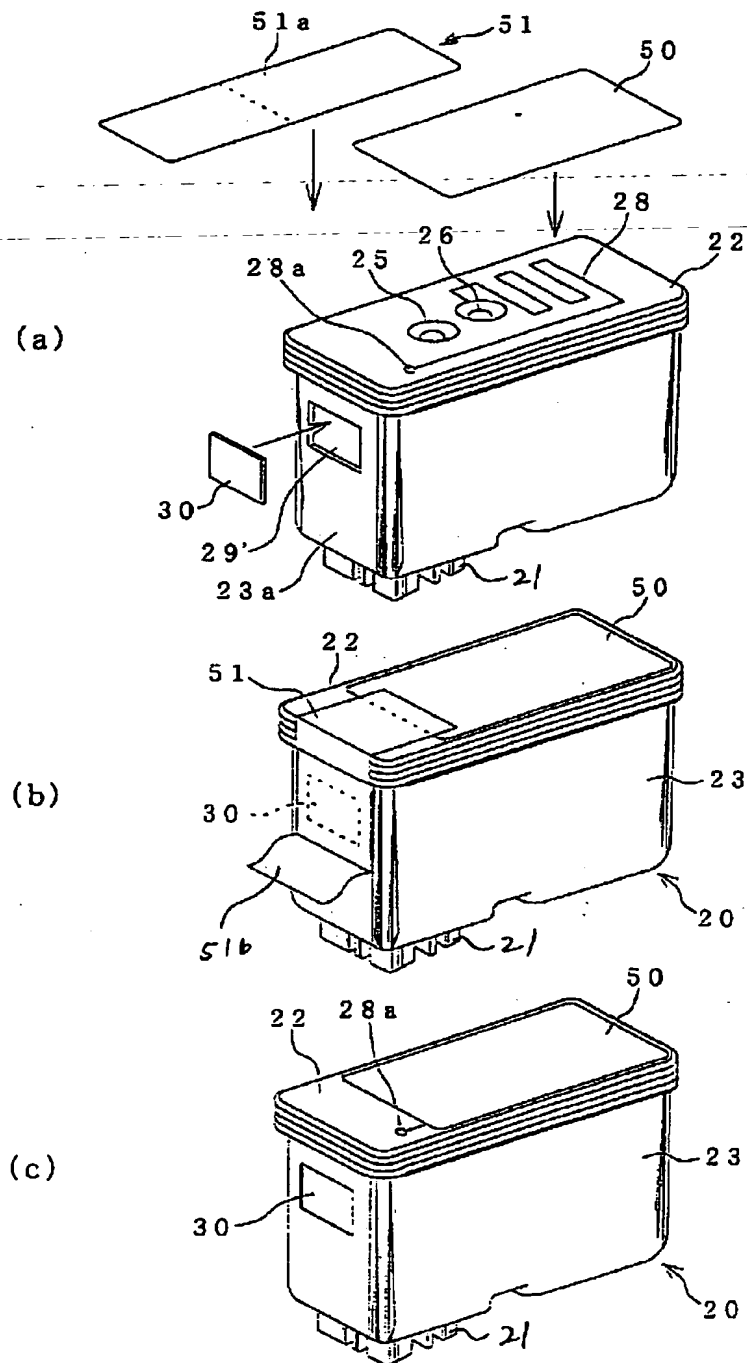


Fig. 7



**Fig. 8**

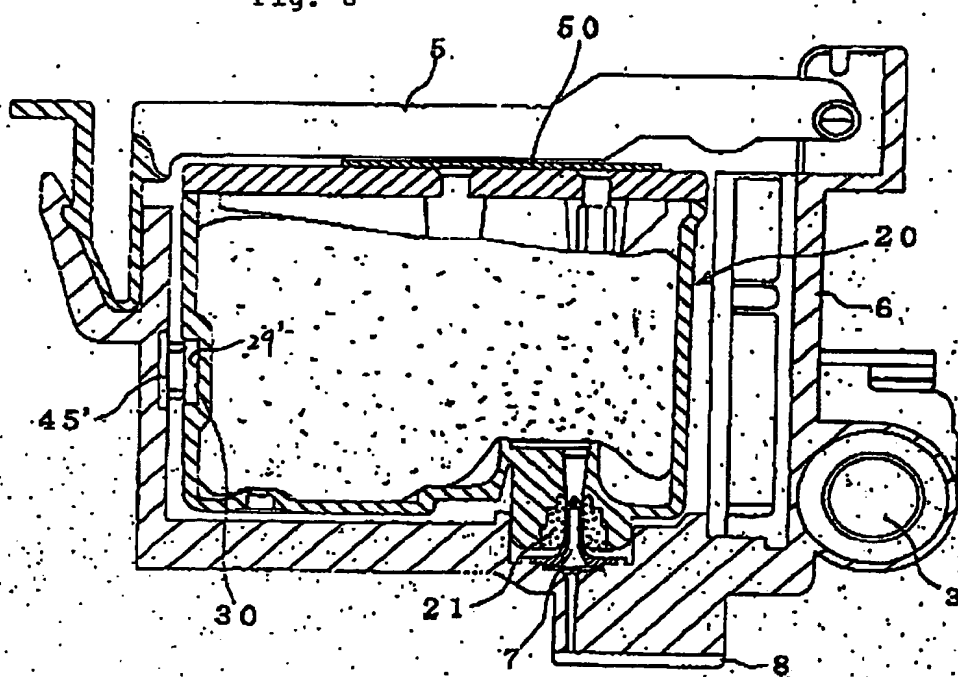


Fig. 9

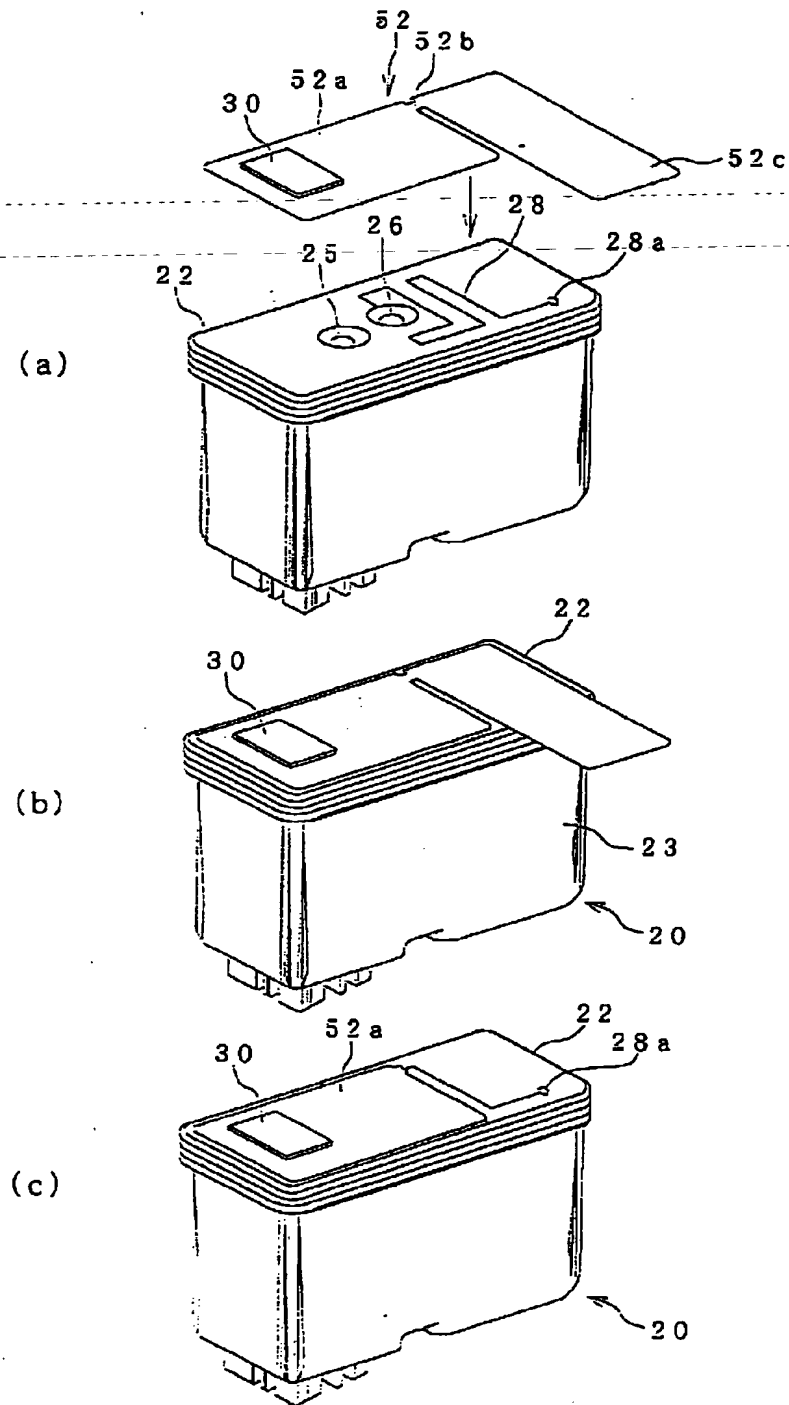
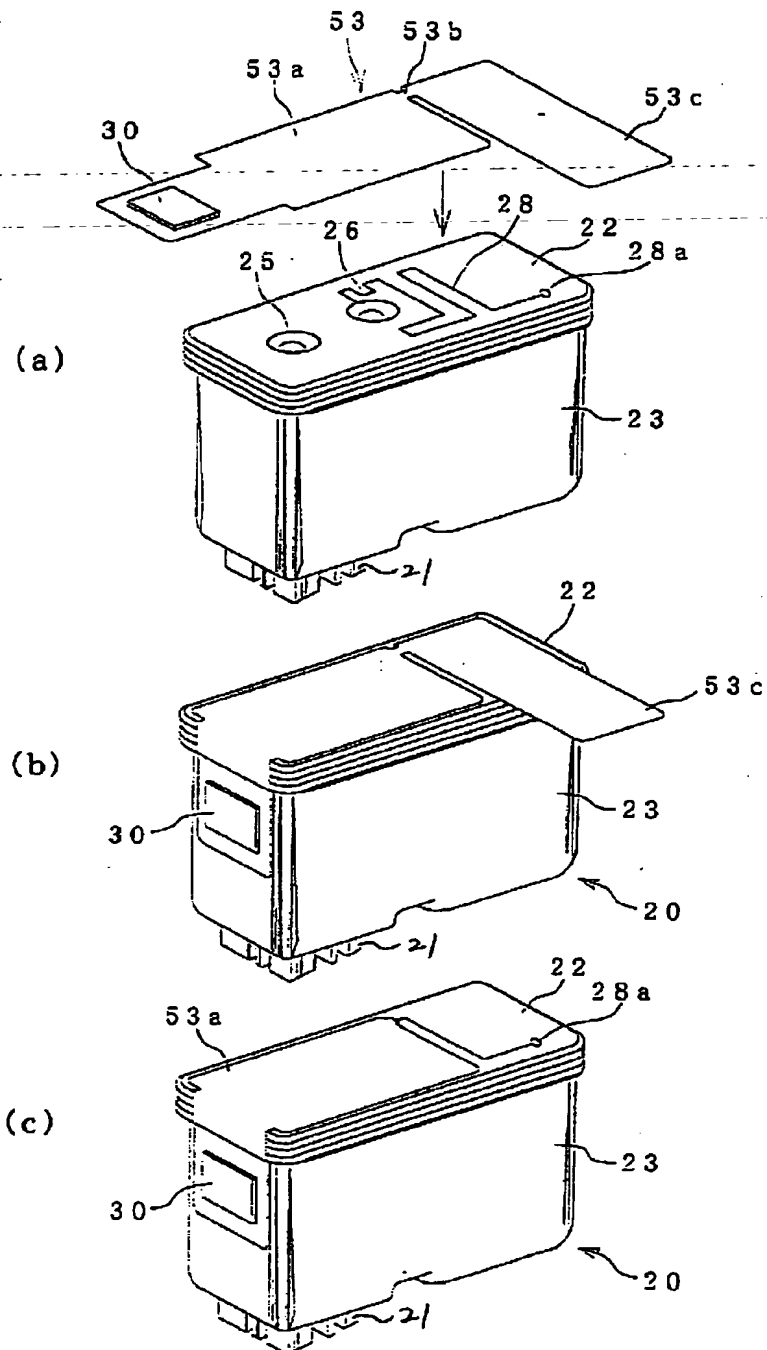




Fig. 10



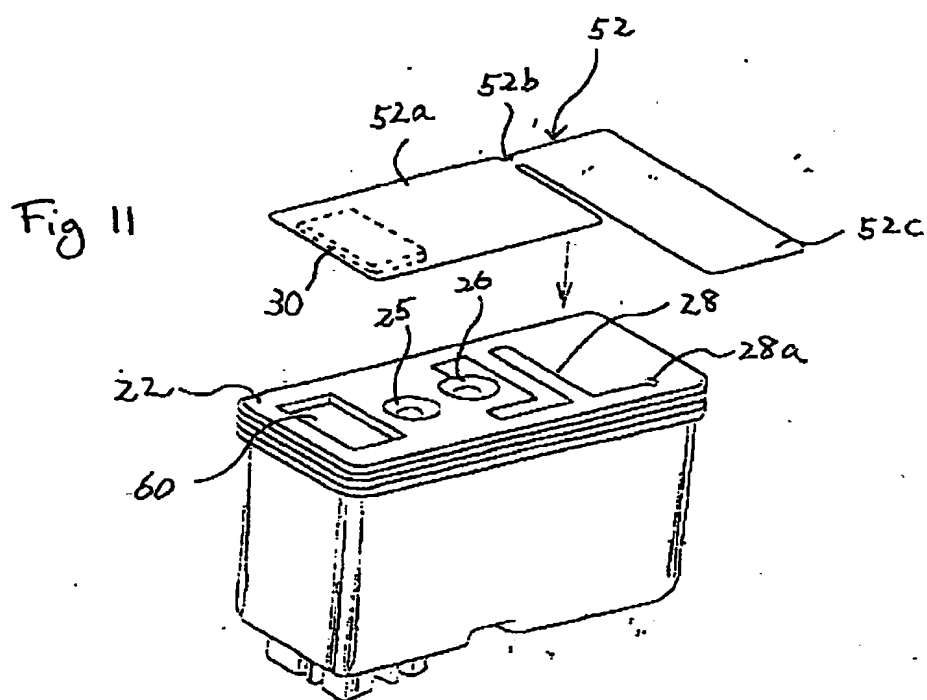
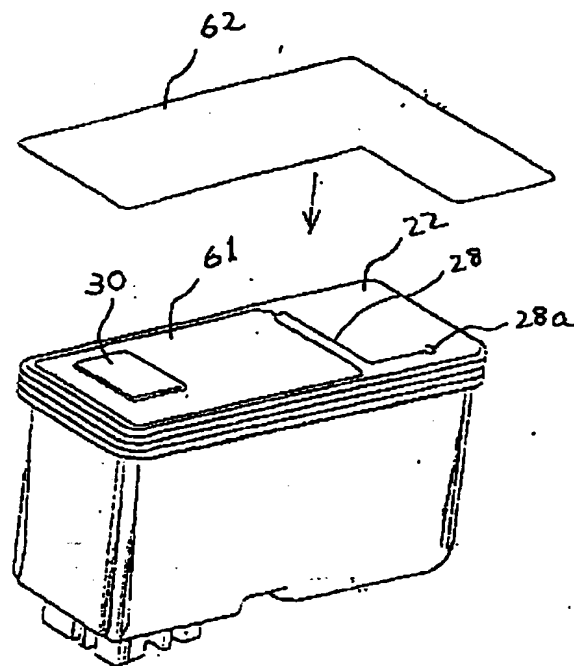


Fig 12



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European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 99 30 3698

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	PATENT ABSTRACTS OF JAPAN vol. 096, no. 012, 26 December 1996 (1996-12-26) & JP 08 197748 A (COPYER CO LTD), 6 August 1996 (1996-08-06) * abstract *	1, 2, 4, 21, 22, 24	B41J2/175
A	---	43	
X	EP 0 440 261 A (CANON KK) 7 August 1991 (1991-08-07) * column 8, line 37 - column 9, line 39; figure 5 *	1, 3, 20, 21, 23, 37	
A	---	19, 36	
X	WO 96 05061 A (ENCAD INC) 22 February 1996 (1996-02-22) * abstract *	1, 21	
A	---	19, 20, 36, 37	
	* page 5, line 8 - line 29; figures 2, 3 *		
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